DOCUMENT RESUME

ED 245 961 SO 015 721

AUTHOR Jacobsen, Judith, Ed.
TITLE Population Change, Resources, and the Environment. Population Trends and Public Policy No. 4.
INSTITUTION Population Reference Bureau, Inc., Washington, D.C.
PUB DATE Dec 83
NOTE 21p.
PUB TYPE Viewpoints (120)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Birth Rate; Depleted Resources; *Developing Nations; *Economic Development; Energy Conservation; Environmental Influences; Futures (of Society); *Overpopulation; Population Distribution; *Population Growth; Public Policy; Quality of Life; World Problems
IDENTIFIERS Food Supply; Fossil Fuels; Gross National Product; Population Control; Wingspread Conferences

ABSTRACT

Intended for policymakers, this document focuses on environmental factors limiting the expansion of the world's food supply, the dilemma of fostering third world economic development, and prospects for energy development. The first of five parts gives an overview of a 1983 Population Reference Bureau conference which focused on current thinking about population, resources, and environmental issues. The second part examines current population growth and efforts to curb world population increase. Countries at zero population growth are listed and tables show absolute increases in world population, slowly growing countries, and regions and countries where families average five or more children. The next part discusses short term (technical, political, and social) and long-term obstacles (soil erosion, misuse of irrigation, and altering natural ecosystems) to feeding future populations. The fourth part addresses ecological, economic, and social implications of using fossil fuels in third world countries and explains ways in which the use of fossil fuels can lead to a higher gross national product (GNP) and a corresponding increase in Physical Quality of Life Index (PQLI). Figures showing relationships between GNP, birthrates, and PQLI are given. The final section, policy choices, concludes that curbing population growth is the most important element of bringing about a sustainable world. (LH)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED245961

POPULATION CHANGE, RESOURCES, AND THE ENVIRONMENT

Population Reference Bureau, Inc.
Washington, D.C.

Population Trends and Public Policy; n4 December 1983

SO 015 721

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

X This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

R. Worrall

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Summary—How can the world's population live in balance with resources it uses and the environment it both inhabits and shapes? In discussing this issue at a recent meeting at the Johnson Foundation Wingspread Conference Center, speakers and participants in particular noted that many important resources, most notably food, depend on the health of the natural world for their continued production. Rapid population growth intensifies the stress on this natural world, often with the consequence of increased human suffering. David Pimentel spoke about the extent of this dependence and the limits already working against expansion of the food supply. Anne Erlich listed and explained the environmental consequences of growing more food in the usual ways, with fertilizers, pesticides, irrigation, mechanization, and a reliance on crops of a single, genetically uniform strain. Stephen Schneider discussed the dilemma of fostering economic development in the Third World and the environmental consequences of that development. The use of additional fossil fuels will be worth the price in pollution, he concluded, if it buys development that lowers birth rates. For the gamble to pay off, though, it must be taken now; delay will exact an enormous price in ultimate world population size and total damage from pollution. The complexity of the problems discussed at the Conference and the overlap among subject areas—food production, energy production and use, environmental quality, family planning, economic growth—suggest the complexity of the remedies required.

POPULATION REFERENCE BUREAU LIBRARY CATALOGUING-IN-PUBLICATION DATA

Population Change, Resources, and the Environment — Washington, D.C.: Population Reference Bureau, 1983.
p. 16 (Population Trends and Public Policy; no. 4)

1. Environment. 2. Population growth. I. Title. II. Series.

HC79.E5P68 no.4 11.83.jb
ISSN 0736-7716

Population Change, Resources, and the Environment is the fourth in a series of occasional papers, *Population Trends and Public Policy*, published by the Population Reference Bureau, Inc. This series is devoted to the discussion of timely demographic issues that are of particular concern to the policymaker. Earlier papers in the series are "The Impact of Immigration on U.S. Population Size" and "Immigration and its Impact on U.S. Society," both by Leon F. Bouvier, and "Population Redistribution in the U.S.: Issues for the 1980s," by Larry H. Long. Papers in this series may be ordered from the Circulation Department of the Population Reference Bureau, Inc., P.O. Box 35012, Washington, DC 20013, at $3.00 per single copy; 2-10 copies, $2.30 each; 11-50 copies, $1.90 each; 51 or more, $1.50 each. Orders of $20 and under must be prepaid and include $1.00 for postage and handling.

Population Trends and Public Policy, Number 4, December, 1983

Editor: Judith Jacobsen

Population Change, Resources, and the Environment

The Population Reference Bureau, Inc., recently sponsored a conference at the Johnson Foundation Wingspread Conference Center in Racine, Wisconsin. Part of a larger PRB project to inform and educate Americans about population, resources, and environmental issues, the Conference brought together 50 people from 18 states for three days of talks and discussion.

Many subjects were discussed at Wingspread—from organic farming to energy-efficient housing design to population growth rates in nineteenth-century Sweden. But a single large question drove all that was said: how can the world's population live in balance with resources it uses and the environment it both inhabits and shapes?

Population growth is a familiar topic; the "population explosion" has been in the news since the sixties. And people know a bit more now about resource scarcities—the Arab oil embargo brought that home to Americans who, unlike many in the Third World, had not since World War II had to cope with a shortage of any kind. People are also familiar with pollution and with efforts to preserve the environment. But not as many are conversant with an element of the population/resources/environment situation that received most of the attention at the Wingspread Conference: that many important resources, most notably food, depend on the health of the natural world for their continued production. Thus abusing the environment, either through overuse or contamination, affects its productivity and can in the long term reduce the resources available.

Rapid population growth intensifies environmental stresses and the environmental damage that lowers productivity, particularly agricultural productivity, often with the consequence of increased human suffering. Kingsley Davis of the Hoover Institution, Stanford, California, set the stage for the Wingspread Conference with his keynote speech on the dimensions of world population growth and the strategies needed to cope with rapid population growth. David Pimentel of Cornell University spoke about the extent of human dependence on the natural world and the limits already working against expansion of the food supply. Anne Ehrlich of Stanford University listed and explained the environmental consequences of growing more food in the usual ways, with fertilizers, pesticides, irrigation, mechanization, and a reliance on crops of a single, genetically uniform strain. Stephen Schneider of the National Center for Atmospheric Research offered a way out of the dilemma we face in choosing between economic development for the Third World and the environmental consequences of that development.

This essay draws chiefly on those presentations but also on some supporting materials. It is intended to bring current thinking about population, resource, and environmental issues as expressed at Wingspread to a wider audience than could attend the gathering.

Dimensions of Population Growth

Regardless of their respective topics, the Wingspread speakers agreed on one thing: that world population growth must be curbed as rapidly as possible. Many of the needs of the current population go unmet as it is. A larger population,

especially one that grows rapidly, will only worsen our present difficulties and may eventually make it impossible to cope at all.

Today, the world population of 4.7 billion is growing at about 1.8 percent a year, down from a peak of about 2 percent in the 1960s. Despite the slowing in growth rates, though, more people are added to the world every year than ever before because of the larger population base. As Kingsley Davis pointed out, the number of people added to the world's population every five years—365 million between 1975 and 1980—is not projected to peak until it reaches 442 million between 1995 and the year 2000 (see Figure 1).[1]

This growth takes place largely in the less developed regions—Asia, Africa, and Latin America. Indeed, 5 percent of the world's population—living in the 11 European countries listed in Table 1—are essentially at "zpg" (zero population growth). Another 20 countries, constituting nearly a fifth of the global population, are growing slowly, at under 1 percent a year. As different as Barbados and the Soviet Union, these countries all have birth rates low enough that their populations will stabilize by the next century if birth rates do not rise. Despite this, however, population increases in the large countries in this group are still substantial (see Table 2), and wealth in some of these countries makes their contributions to global resource depletion and waste disproportionate to their size.

Altogether, the more slowly growing countries account for under 10 percent of the annual increase in world population today, and this share will decline as the years go by. China, which represents over a fifth of the world's population, contributes not quite one fifth of the annual population increase today. If birth rates fall according to plan in China, population will stop growing there in the year 2000. If birth rates fall more slowly, however, which is very likely, world population growth will be greatly increased because of China's enormous size.

TABLE 1
Countries At Zero Population Growth (Natural Increase Under 0.2 Percent in 1983)

Austria	Italy
Belgium	Luxembourg
Denmark	Sweden
Germany, East	Switzerland
Germany, West	United Kingdom
Hungary	

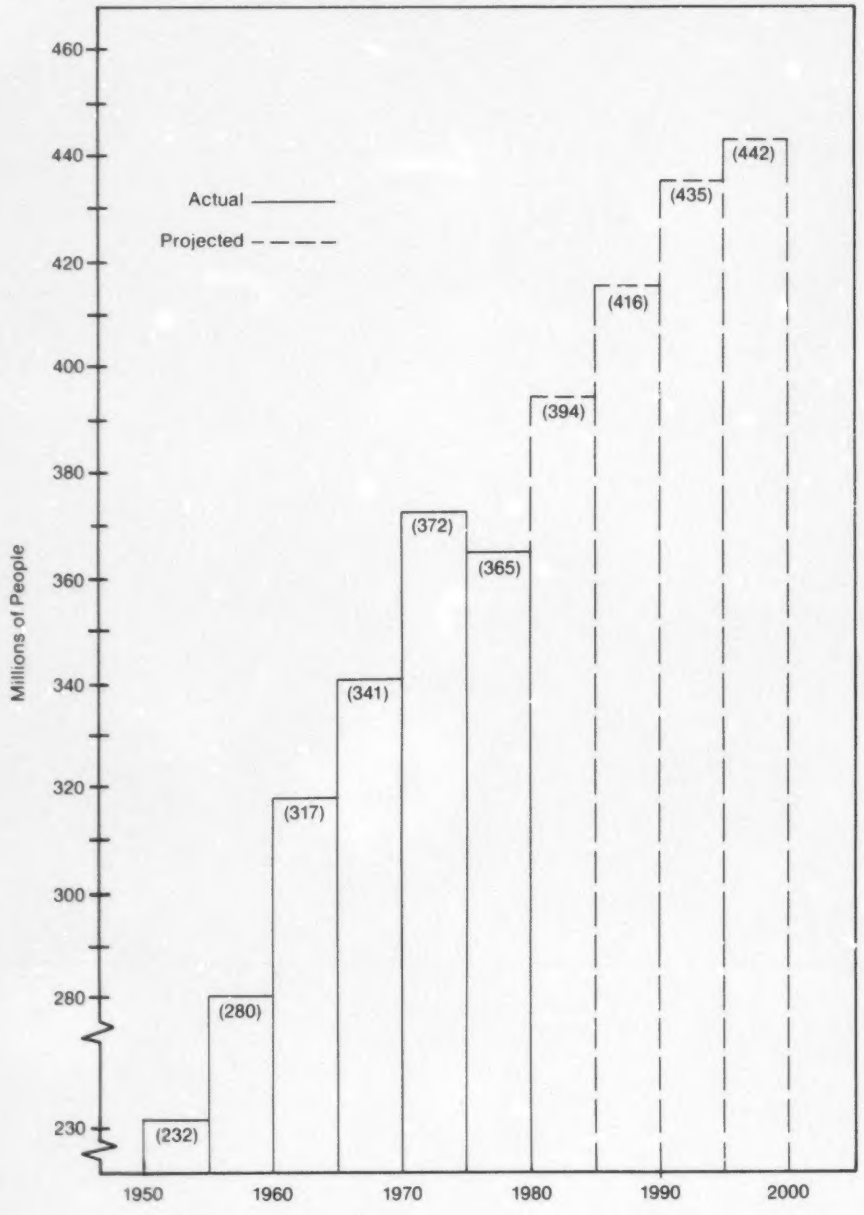
Source: Population Reference Bureau

Thus efforts to curb world population increase are most sensibly focused on the rest of the developing world, where half the world's people live but where almost three-quarters of the increase in world population today occurs. By the year 2000, these countries will contribute 77 percent of the annual population increase if the modest fertility declines projected by the United Nations materialize. Unless fertility falls very rapidly, however, most of the countries in this group will experience enormous population increases over the next few decades.

Nearly half the developing world's people and more than a third of the world's population live in countries where women on average have five or more children during their lifetimes (see Table 3). In these countries, a small fraction of couples use contraception, and birth rates have declined little if at all. The large populations of just three nations—India, Bangladesh, and Pakistan—make up more than half this group.

In countries with the highest birth rates, as many as one infant in seven dies before its first birthday, and families of eight and nine attempt to scratch a living from a few acres of overused land. Some have asserted over the years that the earth has a carrying capacity—a theoretical one—far in excess of the 4.7 billion who inhabit it today. That fact has been used to argue that population growth is not a problem. But these

Figure 1. Absolute Increase in World Population, Five-Year Intervals: 1950–2000



Sources: United Nations, Kingsley Davis

TABLE 2
Slowly Growing Countries
(Natural Increase Under 1 Percent in 1983)

Country	Annual Population Increase	Country	Annual Population Increase
Australia	138,000	Malta	2,400
Barbados	2,700	Netherlands	57,600
Bulgaria	26,700	New Zealand	25,600
Canada	199,200	Norway	12,300
Cuba	78,400	Portugal	59,400
Czechoslovakia	61,600	Romania	181,600
Finland	19,200	Spain	268,800
France	273,000	United States	1,639,400
Greece	59,400	Soviet Union	2,176,000
Japan	834,400	Yugoslavia	182,400

Source: Population Reference Bureau

theoretical arguments are cruelly irrelevant to the facts in many poor countries, the speakers agreed. Already, as Anne Ehrlich pointed out, 15 percent or more of the world's population is chronically undernourished, existing "constantly poised on the brink of starvation, vulnerable to any threat to their meager supply of food."[2] While many circumstances in addition to rapid population growth usually accompany hunger—poverty, lack of education, inadequate health care, and agricultural policies that do not encourage increases in subsistence crop production, for example—it will be difficult and costly to improve living standards of the needy among the world's current 4.7 billion; more population growth would only make an already awesome task more difficult.

Feeding Future Populations

In the year 2000, there are likely to be over six billion people in the world, and unless fertility declines are accelerated markedly in the next few years, the population will not stabilize until peaking in excess of ten billion. Just by the year 2000, if these projections materialize, there would be 45 percent more people in the Third World outside China than there were in 1983; food production would have to increase by at least that much just to maintain current levels of inadequately distributed food supplies. To feed the peak number of people in the world, annual global food production would have to be two to three times today's.[3] But there are physical, political, and financial reasons why such an increase is not assured, despite the unprecedented growth in food production that the world as a whole has enjoyed since World War II. Indeed, the very reasons for past successes in some parts of the world stand in the way of successes elsewhere.

Short-Term Obstacles: In 1950, it took a quarter of a hectare to grow the 248 kilograms of grain per person that was produced worldwide. By 1982, the world's farmers were growing 30 percent more than that per person and using only one- to two-tenths of a hectare to do it. Fertilizer, irrigation, mechanization, and pesti-

TABLE 3
Regions and Countries Where Families Average Five or More Children

Region or Country	Average Number of Children Per Family	Population (in millions)
Africa	6.5	513.0
Iraq	6.9	14.5
Saudi Arabia	7.2	10.4
Syria	7.3	9.7
North Yemen	6.8	5.7
Afghanistan	6.9	14.2
Bangladesh	6.2	96.5
Iran	6.4	42.5
Nepal	6.5	15.8
Pakistan	6.3	95.7
India	5.0	730.0
Burma	5.3	37.9
Guatemala	5.7	7.9
Haiti	5.5	5.7
Bolivia	6.6	5.9
Equador	5.7	8.8
Peru	5.0	19.2
Misc. Small Countries in Asia and Latin America	5.1-7.6	66.4
		TOTAL: 1,699.8

Source: Population Reference Bureau

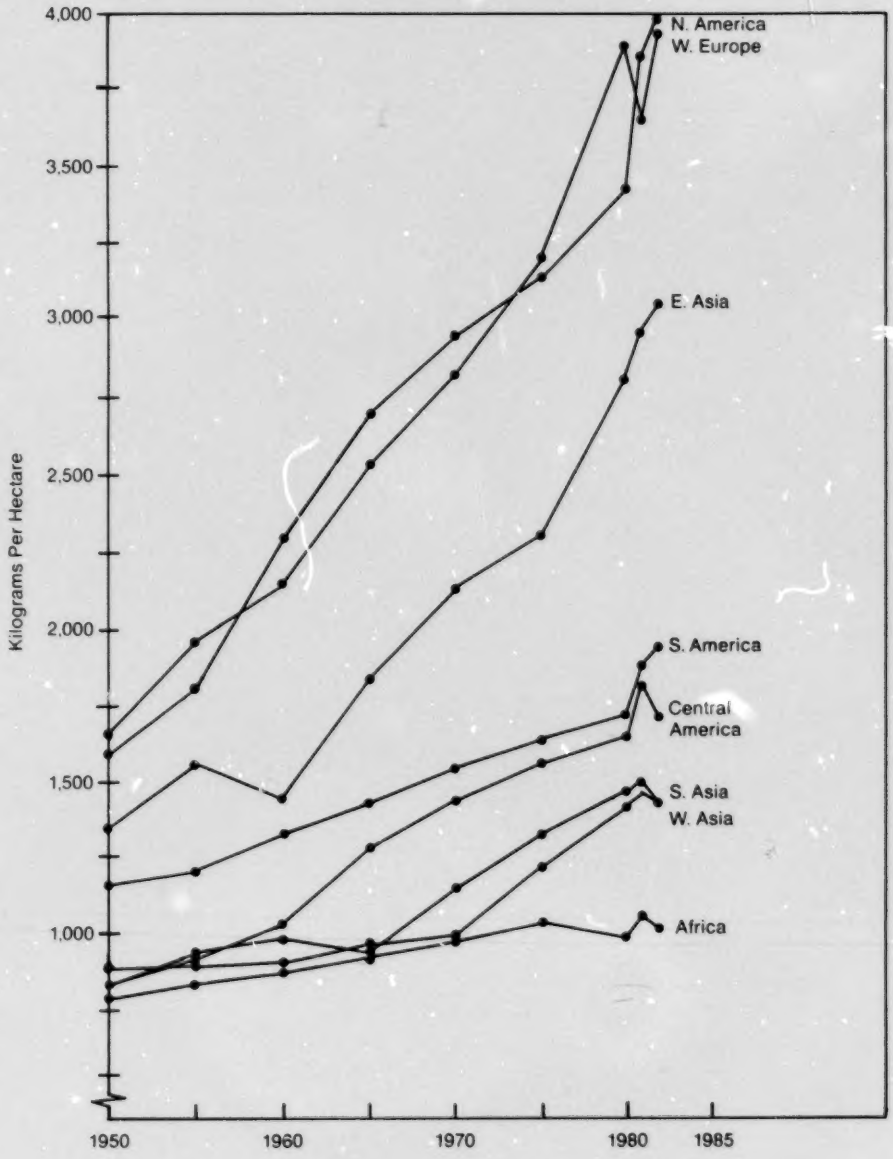
cides used with high-yielding seeds made this possible. In the 1950s and 1960s, most of the increase occurred in the developed world. The development of new, high-yielding varieties of rice, wheat, and corn in the 1970s brought higher yields to the Third World, too. This was the "Green Revolution."[4]

But the benefits of the Green Revolution did not reach everywhere. Grain yields, for example, are still low in most of the developing world compared with North America and Western Europe (see Figure 2). And the reasons the Green Revolution passed these areas by in the 1960s and 1970s stand in the way of future boosts in food production.

Some of the reasons for the failure of the Green Revolution in these areas are technical: some high-yielding varieties were not suited to local climates, for example, or fertilizers and pesticides were not available, even when farmers had the money to buy them. There were also social and political reasons, though, as Anne Ehrlich pointed out at Wingspread. Traditional farmers sometimes resisted the new seeds and farming methods, preferring instead to follow "tried and true" habits of the timing of planting and the choice of crops. Also, where agricultural policies hold down crop prices, farmers had little or no incentive to make investments that would raise production, and because much of the population of some countries is too poor to buy more food, the expanded output of farmers who used new seeds did not necessarily have a ready market.

A new and important deterrent to dramatically higher crop yields in the countries most in

Figure 2. Grain Yields, Selected Regions: 1950–1982



Source: U.S. Department of Agriculture

need of them today is the price of oil and its derivatives, which include fertilizer and pesticides. The price of gasoline, fertilizer, and pesticides deterred poor farmers from using these inputs even before the Arab oil embargo drove prices up; now, at many times the pre-1973 price, it will, if anything, *prohibit* poor farmers from using them today. Indeed, farmers in the industrialized West, wealthy by global standards, have, according to Ehrlich, "been switching to 'minimum tillage' or 'no-till' cultivation" since 1973, in part because of gasoline prices.

Where farmers cannot improve yields by adding expensive inputs, they must in future turn to additional acres to grow more food, as farmers did from the beginnings of agriculture until the modern era. But as both Ehrlich and Pimentel pointed out at Wingspread, no vast areas of productive land wait to be cultivated today; tropical regions once thought of as the agricultural frontier are found to be fragile ecosystems that require expensive inputs to grow crops for even a few years. After that, they can easily become exhausted. Other, less vast land areas that might be cropped are of lower quality than those currently planted, and their yields reflect it.

Competition for even that marginal land is heavy and is likely to intensify. Housing needs necessarily expand with a growing population—one that spreads, logically, onto farmlands that usually surround existing cities and towns. Land resources will become even more important in the future as the world turns to renewable energy as an alternative to expensive and, ultimately, scarce oil. Renewable energy technologies vary in the demand that they make on land; wind machines, solar collecters, and photovoltaic arrays are the least land-using. But raising crops such as corn or sugar cane to produce liquid fuels and damming rivers for hydropower can take enormous amounts of land—often prime farmland. Pimental said at Wingspread, for example, that at least nine times as much land is required to grow enough corn to distill into the ethanol that can fuel an average U.S. automobile for a year than is needed to feed one person.

While competition for the world's limited supply of cropland is intensifying, in the aggregate the world's farmers are experiencing diminishing returns from one of the primary substitutes for additional acres—chemical fertilizer. Pimentel cited Lester Brown of Worldwatch Institute, who has documented these trends: in the early 1950s, the application of an additional ton of chemical fertilizer yielded nearly 15 additional tons of grain for the global harvest; by 1980, this figure had fallen to just under 6 tons.[5] At the Wingspread Conference, Pimentel pointed out that doubling the food supply during the next 25 years "would help offset the serious conditions of malnourishment that 500 million humans presently endure." But to do this "would require a three- to four-fold increase in the total quantity of energy (including fertilizer) expended for food production," because of diminishing returns.

The immediate barriers to expanding food production include the limited availability of agricultural land, diminishing returns from additional inputs of fertilizer and other energy-intensive materials, and the inability of the neediest farmers to make use of yield-enhancing techniques. But overcoming these technical, financial, and political barriers—"succeeding" in feeding the world—could, ironically, be a larger failure in the long run if the world's farmers accomplish the task in the same way it has been done in the recent past. Indeed, boosting the earth's carrying capacity unwisely may erode it in the long term.

Eroding Long-Term Carrying Capacity: An heir spending all of an inheritance is richer more immediately than if the inheritance is invested and the person lives indefinitely on the income earned. But the heir is poorer—poor, in fact, for all time—once the inheritance is spent.

The world faces an analogous, though much more complex, situation as it manages its agricultural resources to feed, house, and clothe its

population. In an effort to grow more, the world's farmers are using up resource endowments—their "inheritance," in effect—in two ways. First, fossil energy in the form of fertilizer and pesticides derived from oil and natural gas and in the form of fuel to power farm machinery and irrigation pumps is being used to boost production. But fossil fuel supplies will eventually be depleted, and the additional productivity these inputs yield is a temporary gain. Second, and more subtly, farming as it is practiced today can diminish long-term agricultural productivity because economic and population pressures discourage good stewardship of the land. And used improperly, high-energy inputs can exacerbate the damage to the earth's "inheritance" of fertile land.

At Wingspread, both Anne Ehrlich and David Pimentel discussed how long-term agricultural productivity is being eroded.

Soil Erosion: A primary difference between a barren planet and the fertile earth is a thin layer of broken-up rock mixed with plant and animal matter, inhabited by tiny organisms: topsoil. As it has for centuries, the earth's topsoil is washing and blowing away. This is partly inevitable: sloping fields will erode. But erosion has accelerated in recent years. Third World farmers, forced by economic and population pressures, are moving onto lands not suited for cultivation, such as steep hillsides, and they are shortening fallow periods on lands once planted to soil-holding cover for periods between crops. Farmers in the developed world—and Third World farmers with access to modern techniques—are also moving onto more erodible, marginal lands. But they accelerate erosion, too, with machines and chemicals that change soil structure and hasten its washing and blowing away.

Pimentel pointed out that in the United States today nearly 200 million acres of farmland has either been "totally ruined for crop production or has been so seriously eroded that it is only marginally suited for crop production." As much as a third of U.S. farmland is being eroded at a rate that undermines soil fertility. Fertilizers and other energy inputs have largely masked the reduction of yields that is inevitable when rich topsoil erodes, though productivity losses are being experienced on some U.S. farmlands already.

Erosion rates in the Third World are nearly double those in developed countries, according to Pimentel, and resources such as fertilizers for offsetting this degradation are not as available. In some areas, farmers are already realizing that their exhausted fields mean the "hungry season" between harvests is lengthening, as those harvests fill less of the grain bins every year.

Misuse of Irrigation: Bringing water to fertile but naturally dry farmland has contributed significantly to expanded food production around the globe since World War II. Indeed, irrigation water, along with fertilizers, pesticides, high-yield grains, and mechanization, has served as a substitute for additional cropland as farmers have succeeded in growing ever more on each acre.

But irrigation has a number of adverse consequences and, as it is practiced in many areas of the world today, cannot continue indefinitely. Irrigation from groundwater lowers the water table if it is pumped at a rate higher than that of the net natural recharge rate. Already, farmers over the Ogallala Aquifer in parts of the U.S. Great Plains have turned off irrigation pumps as the cost of pumping from so deep has exceeded the profit that could be earned from the irrigated crop.

Whether pumped from underground aquifers or diverted from rivers and streams, irrigation water can eventually damage the land it first makes more fertile, by waterlogging and salinization. As irrigation water percolates back into the ground, it can raise the water table to upper layers of the soil, becoming toxic to plants. Furthermore, evaporation from the surface deposits salt from the irrigation water in the soil, damaging fertility. At least half the world's irrigated land—15 percent of the world's cropland is irrigated—has been damaged to some degree by waterlogging or salt buildup, according to

Anne Ehrlich. Without costly correction strategies, these areas will eventually become wasteland. Some already has: Indian analysts report that "nearly seven million hectares of land have already gone out of production because of severe salinity" in India. Another quarter of the 40 million hectares of cropland currently irrigated in India "are threatened by waterlogging and salinity and are in urgent need of attention if they are not to go out of production in the near future."[6]

Altering Natural Ecosystems: Highly productive farms are essentially simplified, human-designed systems superimposed on complicated, natural ecosystems, as Anne Ehrlich pointed out at Wingspread. Rows of crops are highly artificial plant systems that depend for maximum production on fertilizer, mechanized tillage and harvesting, and protection from diseases and pests.

But this productivity comes at a price. Fertilizers and pesticides can poison in their own right, damaging fisheries, polluting water, and affecting the health of farmworkers and consumers. The use of pesticides, too, actually leads in some cases to worse pest problems in the long run, as pest populations quickly develop resistance to new pesticides. The use of large and heavy machinery can alter soil structure through compaction, but also contributes to soil erosion. As Ehrlich pointed out at the Conference, "in the United States, some soil conservation measures (such as windbreaks and contour planting) have been abandoned by farmers because they are incompatible with the use of huge machines."

Replacing a complex natural system with a simplified one also changes the natural system's effect on many things, including the atmosphere, climate, and weather; the cycling of nutrients through the environment; the processing of wastes; and the control of pests and diseases. Anne Ehrlich noted at the Wingspread Conference, for example, that deforestation—the chief cause of which is the clearing of land for agriculture around the world—typically leads to increased problems with floods and droughts in adjacent areas, reduced recharge of aquifers, and accelerated soil erosion; it probably also leads to a warmer and drier local climate. These results ordinarily follow deforestation anywhere, but they tend to be accentuated in the tropics. A similar set of problems attends desertification from overcultivation or overgrazing.

The simplification and destabilization of ecosystems caused by their conversion to agriculture is compounded by planting the cleared natural areas with single-strain crops. Indeed, "a handful of new, genetically quite uniform varieties" of the worlds's major crops—primarily wheat, rice, and corn—has replaced "hundreds to hundreds of thousands of varieties of traditionally grown strains," Ehrlich said at Wingspread. Farmers have adapted these diverse crop strains over thousands of years to local climates and soil conditions and to local pests and diseases. Planting a diversity of crops and crop varieties minimizes losses from an outbreak of pests, a crop disease, or an unfavorable change in weather. A particular disease, pest, or climatic condition to which a widely planted strain was vulnerable could wipe out that crop over very large areas. In 1970, for example, 15 percent of the U.S. corn crop was lost to a new strain of corn blight; in some areas, as much as half of the corn crop was destroyed, Ehrlich pointed out. The Irish potato famine starkly illustrates the consequences of depending on one crop: potatoes were a "Green Revolution" crop in their day for Ireland, because whole families could be fed from a single small plot of land. But in 1846, a potato blight damaged much of this sole food source for the Irish; eventually nearly two million people in Ireland starved to death.

The price, then, of highly productive farming as it is often practiced today can include soil erosion that depletes fertility; waterlogging and salinization that make it impossible to farm some acres at all; and the simplification of natural ecosystems that both depletes soil fertility and makes farming highly vulnerable to

changes in weather, pests, and crop diseases. These consequences counsel against wholesale conversion to similar farming techniques in the Third World, where modern inputs are not generally used. How, then, is the Third World to avoid chronically inadequate food supplies or continual dependence on food aid? Many alternatives were suggested by the speeches at Wingspread.

Per acre yields are currently so low in many parts of the developing world that small amounts of fertilizer or irrigation could boost yields dramatically in the near future. At the same time, more equitable distribution of land and other forms of wealth would enable the poor to invest more in their agriculture and ultimately to grow and buy more food. Farm policies that give farmers a good price for their crops would probably bolster production. Pricing policies, international assistance, and agricultural extension programs that encourage the development of many different kinds of crops, including indigenous legumes, roots, and tubers, would help feed more people. Ehrlich pointed out at the Conference that "when high-yielding rice or wheat is grown in place of beans, more calories but less protein and some other nutrients are produced." If cash crops like coffee or sugar are encouraged instead of food crops, the consequences can be worse.

The adequacy of food supplies now and in the future tells a good deal about whether the basic subsistence needs of a country's population are being and can be met. As crucial as food is, though, more is at stake for the world's poor than food; energy consumption, particularly of fossil fuels, reveals much about overall economic development and improvements in living standards, and it captures the intensity—and probable adequacy—of food production, as well. Stephen Schneider talked at Wingspread about world development in general as reflected in fossil fuel use.

Energy for Development

Today the developing world uses relatively little petroleum or the other fossil fuels, natural gas and coal. Indeed, the Third World, where three-fourths of the world's people live, uses only one-fourth of the world's oil, the dominant fuel. A number of developing countries use less than a single barrel of oil per person a year, while some rich nations use as much as 20 barrels per person annually.[8] As Kingsley Davis pointed out at the Conference, between 1960 and 1979, the world's wealthiest economies increased their per capita consumption of fossil fuels 33 times more than the poorest countries did.

By far the majority of people living in the developing world have little to do with fossil fuels; they rely on fuelwood, dung, and valuable crop residues to cook food and heat water. Indeed, the need for biomass has been called "the other energy crisis"; the poor in much of the Third World scour the landscape for every twig, leaf, and burnable scrap, and the countryside has severely deteriorated. The use of fossil fuels is creating a crisis of less immediate, but truly global, proportions. Acid rain, which damages inland fisheries and streams as well as lake ecosystems and which may damage forests, is closely linked to the burning of fossil fuels. The combustion of such fuels, and of coal in particular, also releases carbon dioxide into the atmosphere. The accumulation of excess carbon dioxide traps heat near the earth's surface; this process, called the "greenhouse effect," may warm the earth's atmosphere enough by the middle of the next century to create warmer and drier conditions in now-verdant farming areas and to raise sea levels enough to flood lowlands throughout the world.[9]

Scientists have said that temperature increases sufficient to affect the ice caps could occur unless there is no growth in world energy use over the next century and the use of coal is

phased out.[10] But closing the global gap in fossil fuel consumption between the rich and poor nations is likely to increase total consumption, particularly if conservation in the developed world progresses slowly. Indeed, a complete and immediate redistribution of total world oil production would give each person in the world four barrels of oil a year, much closer to the current levels in developing countries than in the developed ones.[11] Should developing countries therefore be encouraged *not* to increase their use of fossil fuels, which, in addition to perpetuating the current wide disparity in resource use between the rich and the poor, would probably slow economic growth in the developing world? Or should the Third World move ahead as fast as it can to consume more fossil fuels in the name of economic development, regardless of the environmental consequences?

Schneider offered a way to choose between these two "bad" alternatives. Developing countries should increase per capita consumption of fossil fuels, he said, if it brings about development that can lower birth rates, even though carbon dioxide accumulation and other pollution problems worsen in the interim. Schneider "would be able to accept a little additional pollution now if it meant that ultimately the world population would stabilize sooner and thus future pollution levels would be lower for any per capita standard of consumption" in the world.

High energy consumption is historically associated with wealth. Beyond a certain consumption level, more energy means not wealth but waste; both Sweden and Switzerland, for example, have higher gross national products per capita than the United States, which uses much more energy per capita than either of these two countries.[12] But for the developing world today, increasing energy use "would still bring marginal returns in terms of GNP growth," Schneider said at Wingspread.

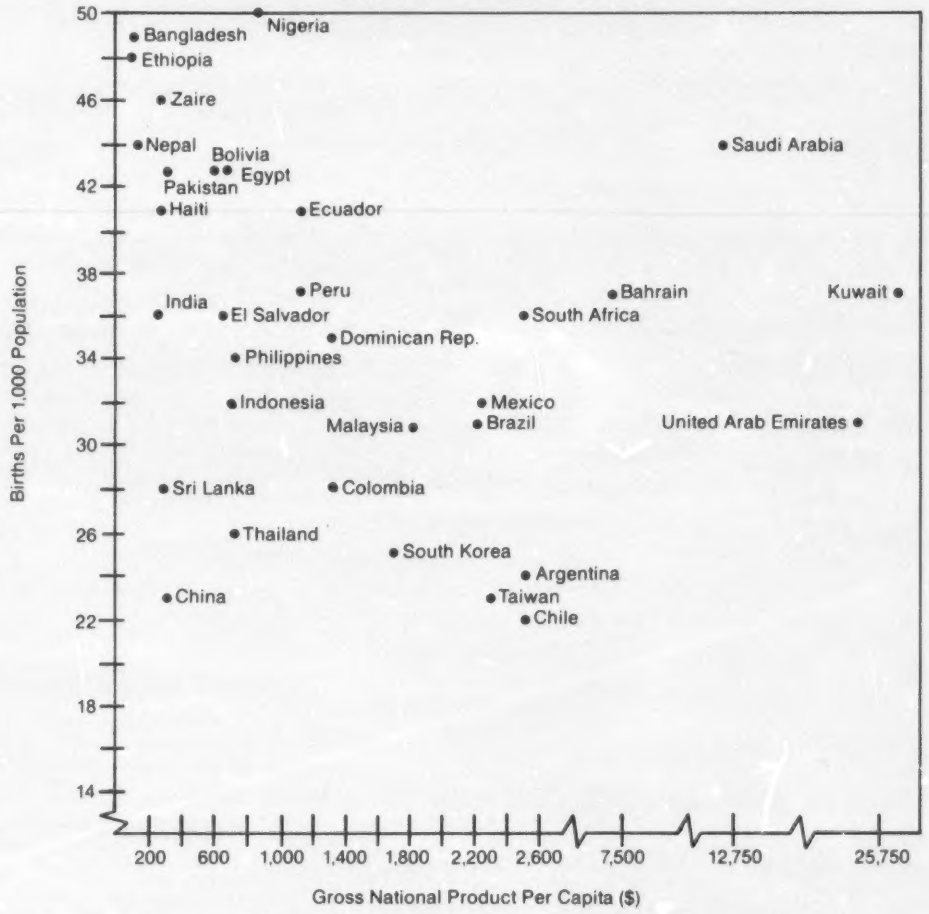
But the use of additional fossil fuels will be worth the price in pollution only if it buys development that lowers birth rates. Otherwise, the world will repeat history's mistakes: more population, consuming more, will only mean more pollution. How can we ensure that higher energy consumption brings development to the Third World that encourages a reduction in birth rates?

More energy usually means a higher gross national product and, by definition, a higher GNP per capita. But more GNP per capita does not necessarily mean lower birth rates in poor countries, as Figure 3 shows. And more GNP per capita does not necessarily mean a better standard of living, as Schneider pointed out in a discussion of the Physical Quality of Life Index (the PQLI).

The PQLI is a number composed of the infant mortality rate, life expectancy, and literacy rate in a country. Each country's rate is compared to the highest and lowest achieved anywhere in the world and assigned a number indexing it to those values. The three numbers are then averaged, with each given equal weight. In the early 1970s, PQLIs around the world ranged from a low of 12 in Guinea-Bissau to a high of 97 in Sweden.

Figure 4 shows that countries with similar PQLIs can have very different incomes per capita. Arab countries, for example, have relatively low PQLIs, even though the per capita GNP in OPEC Arab countries is as much as ten times as high as in non-OPEC Arab countries. In these nations, a rising gross national product does not necessarily raise the PQLI. In Latin American and Asian countries, the PQLI tends to increase as wealth increases. But for any given level of wealth, the PQLIs of Asian countries are higher than in other parts of the world. This may be because incomes are distributed more equitably in Asia than in other regions, according to Schneider. Regardless of the cause, it is clear that per capita GNP is not a reliable measure of well-being as measured by the PQLI.

Figure 3. Gross National Products Per Capita and Birth Rates, Selected Countries: 1983

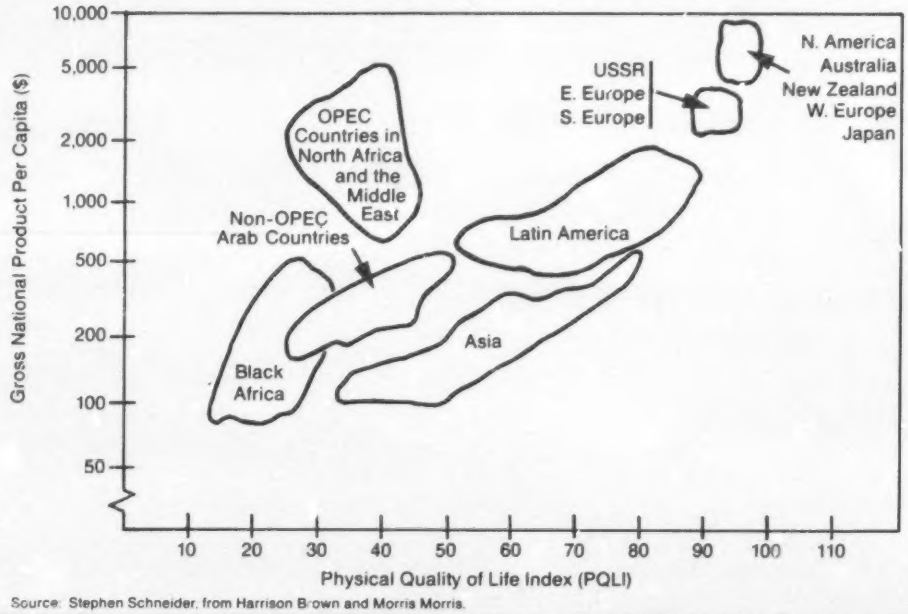


Source: Population Reference Bureau, updating Schneider

There is a close relationship, however, between PQLI and birth rates (see Figure 5), which suggests that countries putting money into strategies that reduce infant mortality, that lengthen people's lives, and that promote literacy are investing in reductions in birth rates. Thus, Schneider concludes that to reduce quickly "LDC birth rates without draconian measures, development strategies must concentrate on bringing up the PQLI, not just raising overall national GNP."

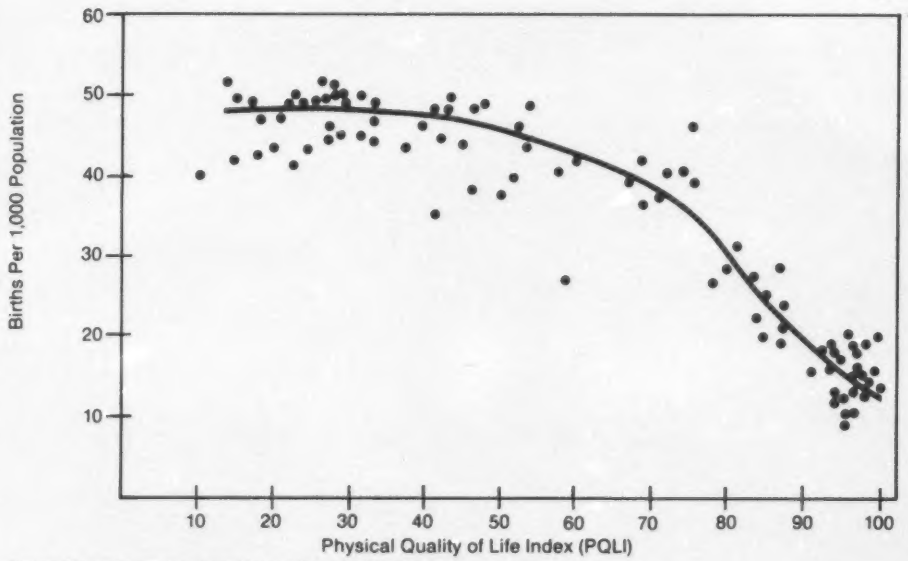
Schneider concludes that bringing up the quality of life and bringing down birth rates in the developing world is worth a relatively small increase in carbon dioxide and acid rain, because the benefits of a lower, stable population size as soon as possible are greater than the risks from marginally more pollution during the transition. For the gamble to be worth it, though, it must be taken now. Delay pays an enormous price in ultimate world population size and total damage from pollution. During

Figure 4. PQLIs and Gross National Products Per Capita, Early 1970s



Source: Stephen Schneider, from Harrison Brown and Morris Morris.

Figure 5. PQLIs and Birth Rates: Early 1970s



Source: Stephen Schneider, from Harrison Brown and Morris Morris.

the transition, too. Schneider pointed out at Wingspread, energy conservation and the development of alternatives to fossil fuels should be subsidized heavily. Reducing waste maximizes the amount of progress that can be attained at the cost of a given amount of pollution; alternatives to fossil fuels are necessary for a sustainable society in the future.

Policy Choices

Everyone speaking at Wingspread agreed that the most important element of bringing about a sustainable world in the long term is curbing population growth. Policies for encouraging a transition to a sustainable society cannot ignore fertility and population growth.

The world population today is 4.7 billion. Even if starting tomorrow the world's couples had no more than two children on average, or just enough to replace themselves, the world population would grow to 7 billion before stabilizing.[14] This is because there are so many young people around the world not yet in their childbearing years. Thus fertility must fall rapidly to prevent the peak population from greatly exceeding 7 billion. How can that be done?

Population growth slowed in Europe and North America as those regions industrialized. This change is called the "demographic transition" and is offered as proof that industrialization will also bring birth rates down in developing countries. But as Kingsley Davis pointed out at Wingspread, modernization that brings wealth such as industrial countries have is a slow process; "in the meantime, the population builds up to the point of interfering with modernization." That phenomenon is already occurring. Rapid population growth, combined with slowly growing or even contracting economies, is preventing per capita economic gains in some countries of the developing world today.[15] Those unrealized gains are the very ones that are supposed to reduce population growth.

Even if a demographic transition could bring birth rates down in the Third World, it could not do so fast enough to prevent enormous projected increases in population, most often in countries least equipped to cope. Unless there is an unexpectedly rapid birth rate decline in Bangladesh, Pakistan, and the sub-Saharan African countries, for example, populations in those areas are projected to triple or even quadruple before they stop growing.[16] These countries are already on the margin of survival; it seems unlikely that even a doubled population could be supported for any significant length of time.

Kingsley Davis offered another reason why a demographic transition will probably not occur to bring down birth rates in the developing world: the situation there is fundamentally different from what it was for the now-advanced nations when they were going through the transition. The less developed countries today have a more rapid population growth rate—and larger absolute additions to their populations every year—than the industrial nations did at a similar stage. But the developing world lacks the frontiers that the United States, Australia, and New Zealand provided to migrating European populations—and to Americans migrating West—in the nineteenth and early twentieth centuries. There is also no resource frontier for developing countries similar to the one they provided colonial powers in earlier days. As a result, land resources in the Third World are strained today as they never were in the now-developed world.

Davis concludes that incentives and disincentives that compete with traditions encouraging large families are essential for birth rates to fall in the Third World. Family planning without incentives allows couples to have the number of children they want, Davis pointed out, which is usually too many for rapid population stabilization.

Combining Davis's recommendation on incentives with Schneider's on Third World

development suggests some strategies that could be financed in the Third World. These are family planning incentives designed to promote economic development and to raise the PQLI. These population policies are, in effect, development projects to lower birth rates.

Any project that creates employment in a Third World country—whether heavy industry, light manufacturing, public works, or a network of cottage industries—provides an opportunity to reduce birth rates. Literacy classes and health care, particularly services designed to improve infant health, can be offered in the workplace. Contraception can be readily available, free, and encouraged with incentives. Pension plans can encourage smaller families indirectly by substituting for child-provided old-age support; they can also be fashioned to compensate workers with two children more generously than workers with larger families. These kinds of projects could also be tried on the village level. Development that also lowers fertility can be promoted in a number of ways, often without increasing fossil fuel consumption on the scale that industrialization does. Villages can be rewarded with development projects—a well, irrigation, a diesel pump, livestock, a biogas plant, a school, roads, parasite control, or low-interest loans—as fertility falls or as more and more villagers use family planning.[17]

Curbing population growth is one of two efforts necessary to bring about a sustainable way of life on earth. The other is reducing consumption in the developed world. The disparity in food consumption between the rich and poor is widely known and documented; both Ehrlich and Pimentel spoke of it at the Conference. Changes in the diets of the wealthy could help relieve some of the stresses on agricultural resources discussed at Wingspread. Decreased demand would allow land, water, energy, fertilizers, and pesticides to be used less intensively. But, as Ehrlich pointed out at the Conference, "nothing short of a virtual reordering of the global political and economic system would be required for the people of the rich countries to reduce substantially their dependence on animal protein."

Less radical adjustments are possible in many other areas of affluent life that would significantly reduce environmental stress without enormous sacrifice—more energy-efficient cars and houses; land-use planning that avoids urban sprawl; pricing and using water for conservation, for example. Just improving efficiency in the use of energy and materials in known ways could stretch resources and reduce pollution a good deal. More research on greater efficiencies would accomplish even more.

Many of the characteristics of a sustainable society were discussed at Wingspread: building energy-efficient homes; developing crop strains that are energy- and water-efficient; widespread family planning services, to mention just a few. The complexity of the problems discussed at the Conference and the overlap among subject areas—food production, energy production and use, environmental quality, family planning, economic growth—suggest the complexity of the remedies required. The world cannot afford to delay in applying known remedies and should be searching actively for new remedies. David Pimentel articulated the alternative to bringing our use of resources into balance with the earth's long-term productivity: if we do not, he warned, "then nature will."

Footnotes

1. Population figures in this paragraph and throughout the essay, unless otherwise stated, are from Population Reference Bureau, *1983 World Population Data Sheet* (Washington, D.C.: 1983) and United Nations, *World Population Prospects as Assessed in 1980* (New York: 1981).
2. Presentation by Anne Ehrlich, Wingspread Conference, Racine, Wisconsin, March 6-8, 1983. Hereinafter, obvious references to presentations at the Conference will not be footnoted. Materials presented by one of the speakers not identified in the text will be footnoted as Ehrlich, Davis, Pimental, or Schneider.
3. Ehrlich.
4. Grain and acreage figures are from Lester R. Brown, *Population Policies for a New Economic Era* (Washington, D.C.: Worldwatch Institute, March 1983), pp. 10-11.
5. Ibid.
6. Centre for Science and Environment, *The State of India's Environment 1982: A Citizen's Report* (New Delhi: 1982), pp. 6-7.
7. Irish potato famine example is from Stephen H. Schneider and Randie F. Londer, *The Coevolution of Climate and Life* (San Francisco: Sierra Club Books, in press).
8. Figures on oil use in developing countries are from Daniel Deudney and Christopher Flavin, *Renewable Energy: The Power to Choose* (New York: W.W. Norton & Company, 1983), p. 11.
9. Explanation of greenhouse effect and acid rain is drawn from Schneider and Londer, *Coevolution of Climate and Life*.
10. J. Hansen et al., "Climate Impact of Increasing Atmospheric Carbon Dioxide," *Science*, August 28, 1981, p. 957.
11. Brown, *Population Policies*, p. 8.
12. This and other facts in this section are from Schneider unless otherwise indicated.
13. Morris D. Morris, *Measuring the Condition of the World's Poor: The Physical Quality of Life Index* (New York: Pergamon Press, 1979), pp. 128 and 134.
14. See, e.g., Tomas Frejka, "Long-Term Prospects for World Population Growth," *Population and Development Review*, September 1981.
15. See, e.g., World Bank, *World Development Report 1982* (Washington, D.C.: 1982).
16. Projected population increase if fertility does not decline rapidly is from computer projections provided by Tomas Frejka, The Population Council, New York.
17. See Judith Jacobsen, *Promoting Population Stabilization: Incentives for Small Families* (Washington, D.C.: Worldwatch Institute, June 1983) for a discussion of incentives in family planning programs.

Population Reference Bureau, Inc.

The PRB gathers, interprets, and disseminates information on the facts and implications of national and world population trends. Founded in 1929, it is a private, nonprofit educational organization that is supported by grants and contracts, individual and corporate contributions, memberships, and sales of publications. It consults with other groups in the United States and abroad, operates information and library services, and issues the publications described on the outside back cover. The PRB also assists the development of population education through formal and nonformal programs.

Officers

•Mildred Marcy, *Chair of the Board*
•Robert P. Worrall, *President*
•Jessma O. Blockwick, *Secretary of the Board*
•Bert T. Edwards, *Treasurer*

Trustees

Jodie T. Allen
Brent Ashabranner
John C. Beyer
Norman E. Borlaug
Wallace Bowman
Michael F. Brewer
John H. Bryant
Marriner C. Eccles, Jr.
Melvyn J. Estrin
Joseph L. Fisher
Frederick G. Harmon
Jonathan Hawley
•Robert Jordan
•Thomas W. Merrick
Douglas T. Parsons
Martha Phillips
•Raymond H. Potvin
Jack Rosenthal
Jonas Edward Salk
Bennetta B. Washington

•Members of the Executive Committee of the Board of Trustees

Conrad Taeuber, *Chairman Emeritus and Demographic Consultant*
Michael P. Bentzen, *General Counsel*

Advisory Committee

Samuel Baum
Calvin L. Beale
Donald J. Bogue
Lester R. Brown
Philander P. Claxton, Jr.
Caroline S. Cochran
Mercedes B. Concepcion
Douglas Ensminger
Philip M. Hauser
Jack K. Henes
Carl A. Huether
Jose Ruben Jara
Sam Keeny
Richard K. Manoff
M. A. Sattar
Benjamin Viel
Sloan R. Wayland

Policy Studies Advisory Committee

Katherine Lyle, *Provost, University of Wisconsin-Madison*
Sara Mazie, *Senior Specialist, Research and Anatysis, Office of Rural Development and Policy, U.S. Department of Agriculture*
Rufus Miles, *former Senior Associate, Woodrow Wilson School of Public and International Affairs, Princeton University*
Robert Parke, *Director, Social Science Research Council*
Lyle Saunders, *Independent Consultant*
Conrad Taeuber, *Associate Professor, Center for Population Research, Georgetown University*

The Population Reference Bureau has been "telling the world about population" since 1929. PRB members regularly receive vital, up-to-date population information from PRB's four annual POPULATION BULLETINS; from the bimonthly, international population news magazine INTERCOM; and the annually updated WORLD POPULATION DATA SHEET and UNITED STATES POPULATION DATA SHEET wall charts. Educator and library members also receive the population education newsletter INTERCHANGE plus ready-to-use classroom materials. PRB publications of particular interest to policymakers are the POPULATION TRENDS AND PUBLIC POLICY series, POPULATION BULLETIN POLICY SUPPLEMENTS, and four-page EXECUTIVE SUMMARIES outlining the policy implications of current U.S. demographic trends. PRB also issues special publications such as the POPULATION HANDBOOK, WORLD'S CHILDREN DATA SHEET, and INTERCOM EN ESPANOL. Write for a listing of publications in print.

For still more information, PRB's Library and Information Service responds to population-related questions by mail, telephone, and in-person visits. PRB's Demographic Information Services Center (DISC) offers personalized, in-depth data and analyses for individual clients seeking professional interpretation of population trends.

For information on PRB publications and membership, write the Circulation Department, Population Reference Bureau, Inc., 2213 M Street, N.W., Washington, D.C., 20037. Individual memberships are $30 per year. The rate for libraries is $40, institutions or corporations, $200.

Population Reference Bureau, Inc.
2213 M Street, N.W.
Washington, D.C. 20037 (202) 785-4664 ISSN 0736-7716